Redwood National and State Parks
Marine Vital Signs Scoping Workshop
January 27-28, 2004

I. PRESENTATIONS

Superintendents Welcome (Bill Pierce & Rick Sermon)

- RNSP has a marine area that has received relatively little focus to ¼ mile offshore
- Most work has been done by partners

Vital Signs Monitoring: I&M Scoping Guidelines (Dr. Penny Latham & Dr. Daniel Sarr)

- I&M perspective of meeting goals:
  - Greater understanding of marine ecosystems in RNSP
  - Develop monitoring questions
  - Develop vital signs suggestions
  - Develop draft conceptual models
- Measure progress (GPRA), meet legal mandates, and inform the public
- Vital signs process: may occur at any level; may be structural/functional/compositional
- Conceptual model: a must for network and park planning effort
- Scale: whole coastline, tidepool, estuary, and so forth

Goals of Scoping Session for RNSP

- Determine conditions of current and future marine ecosystem integrity
- Identify the stressors that cause abnormal conditions of marine ecosystem health
- Identify indicators (vital signs) useful for providing early warnings of impending abnormal conditions of marine ecosystem health
- Identify the level of change needed to detect abnormal conditions
- Develop information necessary to write project statements for inventories (for resources too poorly known to identify potential vital signs) or monitoring studies for the vital signs

Legislation/Jurisdiction (Howard Sakai)

- RNSP's 2000 GMP/GP states that park managers will inventory marine plants and animals and monitor their condition. Need established management goals to meet legislative mandate.
- GMP/GP further states that park policies, including federal and state legislation, dictates complete protection of marine mammals and seabirds and their nesting sites within the parks.
- National Park jurisdiction extends ¼ mile (1,320 ft) beyond the mean high tide line.
- State Park lands extends 1,000 ft from ordinary high-water mark

Aerial Panorama of RNSP's Coastline (Greg Holm)

- Roughly 36 miles of coastline, 17 miles beach and rest rocky coast.
- Rocky coast along northern section; more sand beaches and lagoons along southern portion.
- Video downloaded from website. Pieced together. Copy available in SOC drive/Team/FW/marine scoping session/panorama.ppt

EXISTING KNOWLEDGE OF MARINE ECOSYSTEM RESOURCES:

Intertidal Zones (Dr. Milton Boyd)

- Conducted intertidal study in RNSP in the mid-1970's
- *Note: Has photo record of selected areas of the coastline from 1976. The park should consider scanning original photos, maps and data.*
- Six study sites along RNSP's coastline
  3 Sand Beaches
  - Crescent Beach

- Gold Bluffs Beach (west of entrance station)
- Redwood Creek Beach

3 Rocky Intertidal Sites
- Endert's Beach Cove
- False Klamath Cove
- Point Saint George (north of park)

- Crescent Beach – Highest number and density of invertebrates species of the sand beach study sites. All species at Crescent Beach were represented at Gold Bluffs beach and Redwood Creek beach.

  Invertebrate Species:

  32 Crescent Beach
  8 Gold Bluffs Beach
  11 Redwood Creek Beach

  Crescent beach was the most diverse sand beach. Razor clam and mole crab and sand crab (*Emerita*) were common.
- Endert's Beach Cove – unique rock benches that supports greatest diversity of intertidal habitat of the study sites. Large impressive algal biomass on stable bench shelf at Endert's Beach. Noticeable seasonal change in algal biomass. Some species: gumboot chiton, dungeness crab, *Solaster stimpsoni* (purple band sun star), sea cucumber, perennial and annual algae, coral algae, sponges, mussel beds, sunstar (*Pycnopodia helianthoides*) *Nucella* gastropod, aggregated anenomes (clonal growth), barnacle population. Notice annual growth and change in barnacle colonies.
- False Klamath Cove - Boulder field habitat.
- Damnation Creek – Boulder shingle beach. Very mobile substrate (boulder/cobbles) create sterile intertidal habitat. Few amphipods. Note: abundance of drift logs in upper intertidal areas. Drift logs used to be more common. Logs probably originated from the Klamath and Smith Rivers and Redwood Creek. Logs batter intertidal areas and create disturbance of communities.
- Ossagon Creek – Isolated rocky intertidal habitat on rocks. Rocks show clear demarcation on vertical faces of rocks from the effects of sand burial and scour on biota. Abundance of mussels (*Mytilus californianus*) and barnacles (*Balanus* sp.), *Pisaster ochraceous* and other organisms (e.g., *Anthopleura xanthogrammica*) that can withstand sand burial. Large boulder at Ossagon Creek, isolated patch of mussels on shoreward side; logs a major destructive influence in bashing against rocks thus influences mussel growth/presence.
- Other Comments:
  - Little plant material is consumed by marine herbivores, mostly detritus consumed.
  - Lot of algal biomass in low intertidal zone.
  - Annual recruitment was determined using photo points.
  - Strong seasonal dynamics on algal population diversity; chlorophyll in shore waters probably influenced by upwelling of coastal waters in spring and early summer.

Subtidal Zones (Dr. John DeMartini)

- The shallow subtidal, primarily the rocky component of the Mendocino coastline/Fort Bragg area will be used to indicate some important ecological differences between the aforementioned area and that of the shallow subtidal from Trinidad, Humboldt county, and Del Norte County.
- The shallow rocky subtidal of Mendocino County is characterized by large major grazers, red and purple sea urchins (*Strongylocentrotus franciscanus* and *S. purpuratus*, respectively) and red abalones (*Haliotis rufescens*). Flat and pinto abalones (*Haliotis walallensis* and *H. kamtschatkana*, resptectively) also occur, but not in numbers nor in biomass of red abalones. The large standing crops of the first three grazers correlates well with a photic zone allowing

algae to occur to 50-60 feet or more. Large standing crops of keps, particularly during the summer, like the tall canopy bull kelp (*Nereocystis luetkeana*) and short canopy keps occur. With the advent of the red sea urchin fishery, the standing crops of algae sky-rocketed during the latter half of the 1980s, showing the importance of urchins in limiting the extent of keps and other algae.

- In contrast to Mendocino County, from Trinidad, Humboldt County, to at least Crescent City, Del Norte County, the trophic regime is different. There is a paucity of sea urchins and abalones correlating with a shallower photic zone associated with high turbidity and with algae, particularly kelps occurring no deeper than about 20 feet. For example, when one sees bull kelp at the surface in Trinidad Bay, one can assume the presence of rocky bottom no more than 20 feet deep. While surveying the coast north of the Klamath River around 1980, no bull kelp was seen, except near the harbor of Crescent City.
- Although benthic primary production and grazing are apparently not as important along the northern Humboldt and Del Norte County coasts, suspension feeders and predators apparently do well. Some of the suspension feeders that I presently consider worthy candidates for monitoring purposes will now be discussed. Keep in mind that the following discussion is premised on observations made over two decades ago. **A pilot survey is needed to "truth" the validity of the species discussed below.** Also, a pilot survey may indicate consideration of other species for monitoring the "health" of the shallow subtidal along RNSP.
- Suspension feeders:
  - Stiff-footed sea cucumber (E*upentacta quinquesemita*), this species can occur in huge aggregations measurable in square meters both in the Trinidad area and in RNSP. Apparently, there is nothing under the sea cucumbers other than rock. Aggregations have been seen primarily on sides of sea stacks subjected to strong water movements. My observations indicate to me that large aggredations are also associated with the lack of major predators, Stimpson's sun star and Dawson's sun star (*Solaster stimpsoni* and S. *dawsoni*, respectively). Also, Dawson's sun star consumes Stimpson's sun star.
  - The caprellid amphipod or skeleton shrimp (*Metacaprella kennerlyi*), this species has been observed in aggregations in the square meters also both on Trinidad Head and in RNSP. In distinction to the stiff-footed sea cucumber, the skeleton shrimp is attached to a turf of other suspension feeders like hydroids and bryozoans.
  - The sponge *Polymastia* sp., I do not recall the trivial name of this sponge. I initially thought that it was *P. pachymastia* not uncommon in Mendocino County. However, checking in Kozloff, I found that I had misidentified the species in the ASBS report of 1981. The species is a good indicator of rock commonly covered with a veneer of sand.
  - The sea strawberry (*Gersemia rubiformis*), This soft coral is readily identifiable by its growth form often resembling a batch of strawberries due to its red coenenchyme, the matrix in which the white fleecy polyps reside. The species is uncommon in Mendocino County, but common apparently from Humboldt County on north. It was initially described from specimens collected in Kamtschatka during a Bering expedition.
  - The soft coral (*Discophyton rudyi*), this species was recently renamed by McFadden and Hochberg (2003). I saw it in RNSP a couple of decades ago. Although recorded as far south as Point Lobos, Monterey County. It appears to become more common from Laguna Point, Mendocino County, on north into Southern British Columbia. I am fairly confident that I saw it once at Point Cabrillo, Mendocino County.
  - The zoanthid anemone, the yellow anemone (*Epizoanthus scotinus*), this species is common from Trinidad area on north. It forms sheets of polyps united in a common base and apparently colonies may last for years. Now and then, I have seen aggregations in Mendocino County. In fact, the largest aggregations I have ever seen

were on Arena Rock, Point Arena, with square meters of rock bottom to depts. Of at least 90 feet covered by a colony.
    - The giant green anemone (*Anthopluera xantogrammica*), this anemone is common where food like California mussels (*Mytilus californianus*) drop from the intertidal zone.
    - The white-plumed anemone (*Metridium senile*), this species is often common on the sides of wash rocks and sea stacks and often forms large aggregations.
    - The orange and brown cup corals (*Balanophyllia elegans* and *Paracyathus stearnsi*, respectively), these two stony corals are readily identifiable. The latter species has been observed deeper than the former and apparently withstands sedimentation better.
    - The strawberry anemone (*Corynactis californica*), Not uncommon along the entire California coast, it is evident member of the biota.
    - The plume worm (*Serpula vermicularis*), the white tubes of this worm are readily identifiable.
    - The feather-duster worm (*Eudistylia polymorpha*), Aggregations of these worm are found in large cracks and are readily identifiable because of the worm's large branchial crowns and large tubes. These worms can withstand strong water movements, but at times are removed and found cast up on beaches.
    - The chaetopterid polychaete (*Phyllochaetopteris prolifica*), Large aggregations at shallow depth occur in Trinida Bay and in deeper water on the open coast of RNSP.
    - The black cirratulid worm (*Dodecaceria fewkesi*), this colonial polychaete forms colonies by cloning. The worms secrete a gray calcareous substance in which the worms live. The secretion resembles gray porous rock when detached from rocky substrate and cast up onto beaches.
    - The acorn barnacle (*Balanus crenatus*), this barnacle is dominant along the north coast. During several years of diving in Trinidad Bay and a couple of years at RNSP, rocky bottoms were covered by the tens of square meters by this barnacle. It serves various predators as food like the six-rayed sea star (Lepasteria hexactis), the ochre sea star (*Pisater ochraceus*), and Troschel's sea star (*Evasteria troschel*ii). I add that the sea slug (Onchodoris bilamellata) may be at times a major predator on the acorn barnacle (*B. crenatus*). For example, during 1976, a few specimens of this sea slug were observed during the summer in Trinidad Bay. However, during the summer of 1978, the bottom of the bay was covered with this sea slug and its egg masses. Such variation in abundance can be expected when an invertebrate has a short life span and produces larvae as recruits.
    - The giant acorn barnacle (Balanus nubilus), this barnacle forms large aggregations on offshore sea stacks and wash rocks. I also observed fairly horizontal bedrock bottoms off Point Saint George dominated by this species.
- Predators
    - Sea stars were mentioned above. Neogastropod snails (Ocenebra sp.) are important predators on the above barnacles.
- Recommendations
    - Obtain a temporal overview over several years rather than a snapshot every few decades to aid in assessment of natural variation. Example, the sea slug predator of the acorn barnacle (*B. crenatus*).

Marine Mammals/Seabirds (Keith Bensen)

- **Seabirds**
    - Trinidad to Oregon border coastline is most important area for seabird breeding in California ; 250,000 birds/year; second (Castle Rock – 150,000 birds), third (Green Rock – 55,000 birds), fourth (False Klamath Rock – in RNSP – 25,000+ birds), and fifth (Flatiron Rock – 25,000 birds) largest seabird colonies in California in this area.

- Breeding species confirmed to breed within RNSP: marbled murrelet, common murre, double crested cormorant, Brandt's cormorant, pelagic cormorant, pigeon guillemot, western gull, black oystercatcher, western grebe.
- Other species confirmed to breed in area (between Trinidad and Oregon border): fork tailed storm petrel, tufted puffin, rhinocerous auklet, Leach's storm petrel, Cassin's auklet.
- Marbled Murrelets feed offshore within 2 miles of shoreline with many feeding within RNSP boundary.
- Marbled murrelet intensive offshore counts have been done since 1986, biggest breeding population of murrelets in California is offshore of RNSP.
- Recent studies on movements at sea and inland indicate that vast majority of breeding population of marbled murrelets in California nest in RNSP's old growth forest.
- Most important breeding area in California between Trinidad and Oregon border for following species: 65% population of common murres in state, 46% population of double crested cormorants in state, 100% population of fork tailed storm petrels, 50% population of tufted puffin in state, 60% rhinocerous auklet population in state, 91% of Leach's storm petrel population in state.
- California brown pelican breed in Channel Islands, but offshore RNSP rocks is an important roosting area. White Rock is the single most important non breeding brown pelican roosting rock.
- Monitoring efforts for seabirds is sporadic; USGS and CDFG conducts aerial surveys of offshore rocks since 1978. Some more recent data may need to be analyzed.
- The park conducts seabird counts at White Rock and False Klamath Rock.

- **Pinnipeds**
  - Various inventories conducted on pinniped haulouts/breeding colonies done by HSU graduate students in late 1970's within RNSP. Various behavioral ecology studies conducted by HSU graduate students since then within RNSP, particularly near Klamath River mouth.
  - Harbor seals breed on pocket beaches and forage in parks; monitoring done by HSU's Dr. Dawn Goley recently, still continuing?.
  - Behavioral ecology studies of harbor seals at Klamath River done by Dr. Dawn Goley graduate student most recently.
  - No breeding California sea lions, haulouts and foraging area are important within RNSP for males only. All breeding populations of this species to the south in central and southern California.
  - Klamath River mouth, seals and sea lions eat salmon.
  - Castle Rock haulout site for elephant seals; may get breeding colony as species population expands. Presumably forage in RNSP waters.
  - Stellar's sealions are breeding in the park north of Klamath River mouth; small colony of 30 animals.
- **Whales**
  - Waters within RNSP boundary important role in life cycle of two species - gray whale and harbor porpoise.
  - Harbor porpoise, most important area in California and southern Oregon; forages close to shore. Of estimated 10,000 porpoises in California and Oregon have 7-8,000 offshore of this region. Forage very close to shore, waters within RNSP boundary presumably important. Monitoring by NOAA annually of entire population – still occurring?
  - Harbor porpoise have hard time in central and southern California; bycatch in gill net fisheries. No gill net fisheries in this area.

- California gray whale – at Klamath River mouth; site is a migratory stopover area – see whales here throughout the summer season. Summer feeding aggregation, distinct social groups. Information/monitoring provided by Dawn Goley, professor HSU.

GIS COASTAL PRODUCTS (Dave Best)

- In 2000, the park acquired 1:6,000 color photos for coast from Tolowa Dunes south to Moonstone Beach. Photo coverage extends inland one mile. Developed high resolution digital orthophotographic quadrangles of RNSP coastline.
- Future GIS products – Create photo product with an overlay of distance markers along the coast. This will provide a common reference distance system for the northern California coastline for researchers and coastal managers.
- Aerial Photographs - CDF assembled good digital aerial photographic record of the north coast region that span from 1940's to 2000. Digital photos available on CD from the park.
- Security concerns limit distribution. North coast cooperative geographic data server no longer available after 9/11.

COASTAL OCEAN DYNAMICS (Greg Crawford presented by Jeff Borgeld)

- Notable paucity of information for coastal areas of park. Data available to the north and south of RNSP.
- Talk Outline
  - Winds (locally wind driven circulation)
  - Waves (wave climate influence circulation in intertidal)
  - Currents (coastal currents)
  - Tides and Water Level (important for coastal modification)
  - Riverine Influences (Klamath River Plume)
- Seasonal Winds
  - Winter Season (downwelling) – Strong south/southwest winds; sea level rise in winter; surface water moves towards shore; downwelling.
  - Upwelling Season (mid-spring/early summer) – Surface waters move away from shore; upwelling; surface flow southwards.
  - Oceanic Season (late summer/fall; variable) – lower, variable wind; inconsistent; tidal circulation may dominate during this time period.
  - Circulation wind driven from winter to early summer. Tidal circulation may dominate in late summer/fall.
- Seasonal Waves
  - Large wave events occur annual during the winter. North coast sees 7 m waves virtually every year. (Monthly climatologies for "local" wave data compiled by Courtney Harris, 1998).
- Tides
  - west coast N. America: mixed tides (2 highs, 2 lows per day; the two highs are generally different, as are the two lows)
  - Tidal records show tides with upwelling and down welling signatures.
  - Tides move inshore and away from shore, but also have a component of motion in a north-south direction.
- Currents
  - Wind driven
  - Winter Season (downwelling) – Davidson current northward and onshore.
  - Upwelling Season – southward and offshore
  - Oceanic Season – variable
  - Longshore Current

        - When waves break, water first gets pushed towards shore, then flows back towards ocean. Surf zone = nearshore region where most waves break; swash zone = region of beach which gets covered and uncovered by water as waves wash upon shore.
        - Waves generally break at an angle relative to the shoreline. This induces a net component of motion along the shoreline, called the longshore current, in both the surf and swash zone Water particles, sediments, etc. get moved in zig-zag pattern, with net motion along shore. Longshore current is movement of sand grains. For example, waves from the southwest approaching a north-south shoreline will lead to a net northward longshore current. The transport of materials in this area is called longshore transport.
        - No directional longshore current information but assume in Winter Season longshore current northwards and in Upwelling Season current southward. (Could infer direction of longshore transport with observations of direction from which the waves come, e.g., web camera, perhaps mounted at Requa? Might also provide information on Klamath plume flow).
- River Plumes
    - Large study of Eel River plume from 1995 to 2000. River plume changes dependent on seasonal variablity of runoff (river flow), influence of nearshore and longshore currents (wind driven currents). Plumes may be monitored with remote sensing.

GEOLOGIC SETTING OF COASTAL ZONE (Jeff Borgeld)

- Talk Outline
    - Geologic setting of RNSP
    - Faults
    - Underlying geology
    - Sediment supply and provenance
    - Coastal sediment supply
    - Tides
    - Coastal types
- Geologic Setting
    - Tectonically active geologic setting. Mendocino Triple Junction located to the south. Located along major subduction zone (Cascadia Subduction Zone). Offshore of RNSP is the Gorda Plate. Structures (folds and faults) associated with subduction zone fractures coastal zone.
- Faults and Folds
    - Better mapping offshore than onshore. Offshore is a fault and fold belt which extends onshore. As a result of geologic setting, all structure and topography in north coastal areas are oriented in a NW-SE trend.
- Bedrock Stability
    - Reference: Moley, C. and Dengler. L. 1992. Geology and Ground Shaking: Northern California. Four-color map at a scale of 1:250,000 that shows faults and general subsurface geology and their relationship to localized ground shaking.
    - Along coastline there are moderately consolidated sediments (e.g. Gold Bluffs Beach; south coastline of park), unstable bedrock (mid-coastline of park), and moderately stable bedrock (harder rock sandstone; e.g. south of Endert's Beach; north end of park).
- Coastal Sediment Supply
    - Klamath River sands are different than Redwood Creek because of underlying bedrock in the watersheds. Many coastal rivers, like Redwood Creek, drain Franciscan terrain. Klamath River drains from harder rock terrains.

- Heavy Mineral Study of Sand Source:
  Rivers have different mineralogy due to underlying bedrock and have distinctive heavy mineral signatures. Sands along the coast indicate a Klamath River or Redwood Creek source. Somewhere along the park coastline is the transition from sediment derived from Klamath River versus Redwood Creek. Gold Bluffs Beach sediments near Fern Canyon have a Klamath sediment source based on heavy minerals. Green amphiboles and hornblendes give sand green color. Nearer Redwood Creek mouth, sand supply from Redwood Creek increases. Sand has fewer darker minerals such as amphiboles and hornblendes.

- Coastal Sea Levels
  - Crescent City tide gage data (May 1933 to present). Range 0.5 m seasonally because of wind driven water against coast.
  - El Nino – Higher coastal sea level drives coastal erosion. Generally higher coastal erosion in El Nino years.
  - Global Sea Level Rise – global sea temperatures warming up. Coastline in Erosional phase.
  - Crescent City tide gage shows sea level stable. Checked mean sea level differences along coast from Arena Cove, CA to Depoe Bay, OR for 1960-1978 versus 1983-2001. Expect 0.15 to .2 (1/2 cm) average increase in residual over time period. Port Orford and Crescent City –0.01 and indicates a stable sea level.
- Coastal Types for RNSP
  - Based on coastal oblique photos at www.californiacoastline.org. Examples of coastal types include:
    Sandy Beaches
    1. Sand eroding with back terrace (e.g. South end of Endert's Beach) - mobile sandy beach.
    2. Beach with backing vegetated forest (e.g. Humboldt/Del Norte County Line) - Equilibrium beaches; small scattered locations; vegetation down to coastline/beach; don't expect beach to change much in the short term.
    3. Beach with backing incipient dunes (e.g. Gold Bluffs Beach) - Regressing coastline; beach prograding (growing).

    Rocky Coast
    1. Coastal cliffs in moderately stable bedrock (e.g. North of Sisters Rocks) – doesn't shed blocks.
    2. Unstable bedrock (e.g. North of County Line/South of Split Rock) - source for large blocks on the beach.
  - Coastal Landslides – lots of landslide scars on coastal photos. Coastal landslides locally affects sediment supply; provides sediment source that is episodic in nature; landslide scars are not a major source of sediment since material failed already. Gold Bluff beach is emergent and tied to Klamath River sediment moving to the south in longshore current.

California Regional Water Quality Control Board 2003 Report (Howard Sakai)

- Report titled "Discharges into State Water Quality Protection Areas"
- Identified 73 total discharge source types (41 discharges, 27 outlets, 5 springs/seeps
- Klamath River does not meet water quality standards for temperature from non-point sources, and nutrients and organic enrichment/low dissolved oxygen from both point and non-point sources.
- Redwood Creek is impaired due to sedimentation/siltation.

- Requa facility treated wastewater discharge is a point source that is not in compliance with the Ocean Plan prohibition, thus requires an exception from State Water Resources Control Board.
- Most drainages is due to runoff from rural and wilderness watershed
- Rugged cliffs and sparse primitive campgrounds dominate this region and much of the coastline is limited to foot traffic

Estuaries - Klamath & Redwood Creek (David Anderson)

- Klamath River is relatively unaltered compared to Redwood Creek estuary. No research in Klamath by NPS. USFWS, CDFG, and Yurok tribe have conducted extensive research and monitoring of salmonids in the Klamath River estuary.
- Klamath River estuary marine species include: Dungeness crab, green sturgeon, white sturgeon, American shad, Pacific herring, northern anchovy, surf smelt, longfin smelt, eulachon, cutthroat and steelhead trout, coho salmon and Chinook salmon, pink salmon, threespine stickleback, shiner surfperch, Pacific staghorn sculpin, and starry flounder.
- Redwood Creek levees have reduced and degraded available habitat. Sedimentation changed the estuary. Aerial photos: 1948 pre-levee, and post-levee May 1988 and May 2003 showed no change to degraded estuary mouth
- Cindy Ricks MS thesis on flooding and sedimentation at the mouth of Redwood Creek showed that most of the sediment in the estuary is of marine origin, most which is from the Klamath River.
- Wave action pushes sand into the estuary, but sand is not being flushed out since levees changed circulation patterns and bypassed the last meander of Redwood Creek.
- Marine fishes that have been captured in the Redwood Creek estuary are Pacific herring, surf smelt, night smelt, eulachon (now gone), threespine stickleback, staghorn and prickly sculpin, shiner surfperch, rubberlip surfperch, saddleback gunnel, starry flounder, Chinook and coho salmon, and steelhead and coastal cutthroat trout. Surf smelt are in Redwood Creek estuary when they run on beach. Other species observed are Dungeness crab, mysid and bay shrimp, sea slug, and sea gooseberry comb jelly.
- Have a 20 year surface water elevation record for Redwood Creek estuary.

CURRENT ON-GOING MARINE PROGRAMS:

RNSP's Programs (Greg Holm)

- Park Initiated
  - Beached Carcass Surveys (Snowy plover)
  - Breeding seabird monitoring
  - Marine mammal monitoring (Steller's sealion)
- Park Participant
  - Marine Life Protection Act
  - North Coast Area Contingency Plan
- Beached Carcass Surveys
  - Purpose = collect baseline data for natural die-offs and variation in the environment
  - Monitor for anthropogenic mortality
    Fishing line/garbage entanglement
    Oil/chemical spills
    Other
  - Started in 1997 – two surveys in winter (Dec-Jan), 3 in summer (May-July), usually found about 100 carcasses per year
  - From 2000 to present – two surveys in winter, and 8 more (1 per month) from March to October, find about 400-600 carcasses per year (tag data)

- Cover about 17 miles of beach each month
- Along with snowy plover surveys, RNSP staff have walked about 2,200 miles on park beaches since 2000

- Other on-going programs
  - Monitor select offshore rocks (False Klamath Rock and White Rock) during seabird breeding season
  - Attempting to monitor Steller sea lions near Klamath (Requa area)
  - Participates in the North Coast Area Contingency Plan response system. A multiagency and jurisdictional effort. Almost all of RNSP coast is identified as "sensitive sites" for breeding/feeding seabirds, marine mammal haulouts and anadromous and surf fish
  - Marine Life Protection Act (MLPA). Headed by CDFG (marine resource managers). RNSP participated in the North Coast Regional working group before the group was disbanded due to state budget constraints.

Intertidal/Subtidal (Sarah Cox, Dr. Tim Mulligan, Dr. Sean Craig, Cara McGary)

- Goals
  - To establish a baseline assessment of habitat and species (Quantify patterns of abundance, distribution, and diversity of macrophytes, macro-invertebrates, and fishes)
  - Set up community study project
  - Re-inventory 1974-76 Boyd & DeMartini plots
- Potential intertidal study sites
  - Rocky sites (False Klamath Cove, Endert's Beach cove, 1-2 additional sites)
  - Sandy sites (Crescent beach, Gold bluffs, Redwood Creek beach, etc.)
- Sampling Periods
  - Spring, Summer, and Fall (Winter conditions being too unpredictable and potentially dangerous precludes sampling)
  - Bi-monthly site sampling, based on monthly low tides
- Why establish a baseline assessment?
  - Determine current condition of ecosystem
  - Track seasonal fluctuation and long-term changes, What are the normal limits of variation?
  - Management strategies (discover abnormal conditions, suggest remedies, effective management actions)
- Species Inventory
  - In collaboration with University of California Santa Cruz Partnership for the Interdisciplinary Study of Coastal Oceans (PISCO). Trained team of samplers. Protocols already in place.
- Monitoring Strategies
  - Random quadrat sampling with key species
  - Photo plots/overview site photos
  - Tidal height/conditions
  - Water samples (temperature, dissolved oxygen, salinity, chlorophyll?)
  - Each transect divided into 3 zones – high, mid, low
  - One quadrat per zone (3 quadrats per transect) = 33 quadrats per site.

Effects of Treated Crescent City Wastewater on Rocky Intertidal Environments (Karen Warburton and Dr. Milton Boyd)

- Goals:

- Determine for changes in species diversity and occurrence of invertebrate communities between a treated wastewater rocky intertidal output site and a control rocky intertidal site.

- Study locations: Treated wastewater rocky intertidal outfall is located at the Battery Point Lighthouse in Crescent City. The area receives lots of wave action. The control site is located at Endert's Beach. The Endert's beach rocky intertidal site is similar in micro-topography with the treated intertidal site, receives similar wave exposure, and is at the same elevation.
- Sampling methodology
  - Random locations selected at both sites
  - 0.25 m^2 quadrats placed on substrate
  - Censused quadrats for occurrence and abundance of intertidal plants and animals
  - Thirty quadrats surveyed at each site
  - Sampling occurred in summer 2003, spring 2003 and summer 2003
- Reported study results are preliminary as just in the infancy of analyzing the field data.
- Salinity at output area is 26.0 to 27.7 ppt and adjacent water measured 33.8 to 33.9 ppt. No obvious patterns of disturbance to indicator algal species such as the green algae *Ulva, Enteromorpha*, and *Codium*.
- Both treatment and control sites had typical occurrence/abundance patterns as for other areas in Northern California. Thirty-one species were detected at the treatment site and 30 species were found at the control site.
- *Semibalanus cariosus* (thatched barnacle) was the most abundant species at both the treated and control sites. *Mytilus californianus* (California mussel) was the next dominant species at both sites. The next two common species in order of abundance differed between the treated and control sites. *Endocladia muricata* (branched red alga) and *Microcladia borealis* (red alga) were the next abundant species found at the treated site. *Pollicipes polymerus* (goose barnacle) and *Collisella digitalis* (California fingered limpet) were the third and fourth most abundant species found at the control site.
- No *Microcladia borealis* (small branched red alga) and *Neorhodomel larix* (red-black alga) were found at the Endert's beach control site.
- Very few *Collisella digitalis* (California fingered limpet) and *Notoacmea fenestrata* (Finestrate limpet) were found at the treated site despite their higher abundance in the control site.
- Further analysis need to be conducted.

POTENTIAL PARK STRESSORS

Natural Resources (Kristin Schmidt)

- Anthropogenic stressors
  - Oil spill, threat of spill from offshore shipping traffic. Parks participated in the development of the North Coast Area Contingency Plan to deal with potential oil spills.
  - Fishing, commercial fishery for bait fish via vehicle access on beach. Offshore – live fish and crabbing. Extant of fishing pressure is unknown. Recreational (sport) fishing from the beach and by boat.
  - Traditional uses – Native Americans allowed to drive on Gold Bluffs beach anytime.
  - Boccacio – federal candidate but open to fishing.
  - Invertebrate impacts from recreational fishery is unknown. Invertebrates may be taken with state fishing license; abalones, mussels, sea urchins and other species may be harvested with a sport fishing license on state and national park beaches.
  - Klamath plume effects on intertidal/subtidal areas maybe a problem.

- Tidepool impacts from visitor use are unknown.
- Permitted fisherman and park rangers access beach by vehicles; visitors access beach. Affect some listed species like brown pelican and maybe snowy plovers. Although completed consultations with USFWS for impacts from these activities were determined to be not adversely impacting brown pelicans.
- Snowy plovers were detected for first time in 20 years (like to hunker down in tire tracks and depressions created by vehicles and humans).
- Elephant seals may be seen more in future as one was observed in 2003 on Gold Bluffs beach.
- Rock climbing and cliff climbing – concern around pinniped haulout areas. Some sites are advertised on web.
- Aircraft – maintain overflight ceiling of 500 ft. over T&E species habitat; 1000 ft. ceiling required by NOAA over offshore rocks and for pinniped haulouts. Private aircraft routinely fly lower than 500 ft as does the Coast Guard.

Cultural Resources (Karin Anderson/Tom Gates)

- Karin Anderson
  - Offshore park coastline is within Yurok and Tolowa ancestral lands.
  - Compliance for Natural Historic Preservation Act
  - Archaeological sites, little data on shipwrecks; not slated for cultural resource inventory until 2011
  - Look for physical effects like ground disturbance and permanent changes. Also look at access points that pass archaeological sites or seasonal cultural uses.
  - Tom Gates, Yurok tribe, will discuss traditional cultural sites.
- Tom Gates
  - Half of listed species in handout is of importance to the Yurok tribe
  - Historic use, stories, etc. of importance to tribe
  - Ten to 15 village sites, 30-40 gathering sites along coast
  - Gathers would not like to be looked at as stressors, but as managers that enhance an area (e.g., seaweed – distribute for family network, important for stomach); long-term gathering.

Ocean Parks and Vital Signs Monitoring (Gary Davis)

- Gary spent about 30 minutes introducing the group to why, how, and their roles in the vital sign scoping session. His discussion touched on the following topics: an introduction to the fundamentals of park stewardship, description of the NPS's environmental vital signs monitoring program, and an outline of the program design process we'll use at this workshop.
- Seventy National Parks on the Coast (Ocean and Great Lakes)
- Thirty-five million acres of prime coastal habitats
- Four thousand six hundred miles of shoreline (RNSP 36 miles).
- Forty parks include 2.5 million acres of submerged lands (RNSP 5,939 acres)
- Today we know that:
  - Rare, extreme natural events shape ecosystems, they do not destroy them
  - Predators mediate competition and structure ecosystems, they are essential to sustain biodiversity
  - Human activities now dominate earth's ecosystems
- We need to:
  - Know and understand resource conditions
  - Restore impaired ecosystems
  - Protect resources and ecosystems, and mitigate threats

- Connect people to parks

	Research Science	Applied Science	Field Operations
KNOW	Design Protocols	Monitor Resources	Observe Conditions
RESTORE	Develop Techniques	Apply Techniques	Explain Needs
PROTECT	Evaluate Efficacy	Mitigate Impacts	Enforce Laws
CONNECT	Test Methods	Diagnose Issues	Describe Effects

- Knowledge of resource conditions helps set goals, determine normal conditions & evaluate performance of restoration and protection
- Understanding how resources interact helps predict ecosystem behavior and project consequences of intervention or lack of action
- Knowledge helps connect people to parks
- Vital Signs, The answer determines:
  - What to measure
  - When to measure
  - Where to measure
  - How to measure
  - Accuracy and precision needed
  - How to report results
- What to choose to monitor:
  - Easy to measure key species demographics
  - Populations integrate effects of environment
  - Project future conditions, early warning
  - Sensitive to sub-lethal chronic stress
  - Interpretation and applications often direct
- Develop Conceptual Model
  - Set Limits (boundaries on system to monitor)
  - Inventory Resources (Conduct field surveys, Review literature and survey collections)
  - Make exhaustive list of mutually system components (Define biogeographic units such as watersheds or ocean currents or etc.; and determine appropriate taxa and scales of time and space)
  - Identify relationship among system components including stressors
- Selection criteria for biological vital signs:
  - Representative, broad ecological array
  - Common, dominant structural elements
  - Special legal status
  - Endemics
  - Exploited
  - Invasive aliens
  - Charismatic
  - Practical
- Other considerations:
  - Reduces uncertainty
  - Reduces cost
  - Increases success
  - Increases effectiveness
- "…there is nothing more difficult …..than to initiate a new order of things." Nicole Machiavelli 1525
- "Take a stand. Make a difference. Do what you can with what you have, where you are." Col. Teddy Roosevelt, San Juan Hill, Cuba 1898

- How to proceed in RNSP's vital signs workshop:
  - Decide how we want to decompose the complex RNSPs ocean environments into tractable units – conceptual model
  - Break out into small discussion groups to identify critical elements of those systems to monitor as "Vital Signs"
  - Describe the goals, objectives, and work to be done in developing monitoring protocols

II. REFERENCES

Boyd, Milton, B and DeMartini, John D. 1977. The intertidal and subtidal biota of Redwood National Park. Contract No. Redwood National Park. CX8480-4-0665. 162 pg.

NRBIB Abstract This study at Redwood National Park examined three intertidal sites and a sand beach from July 1974 to June 1976. The substrate, as well as degree of protection from waves and the resultant slope, is found to affect the composition of the resident marine community. Severe conditions during winter favor establishment of annual species, and the survey identified 168 species of invertebrate animals, 8 fish species, and 87 plant species. General information about the park's coastal environment and intertidal areas is followed by details of the specific sand beach and rocky intertidal habitats studied. A separate chapter by DeMartini describes the little-known immediate subtidal biota, surveyed using SCUBA gear. The final chapter discusses management considerations and suggested strategies. Includes black-and-white photographs of tidal areas, many detail maps, drawings showing zonation, data graphs and charts, lists of sand beach animals (one showing relative abundance of some at Crescent Beach), effects of sand compaction by vehicles, list of nearly 50 intertidal algal species (occurrence, abundance), macroinvertebrate densities at the rocky intertidal sites, and others. Five appendices list the plant, fish, and invertebrate species.

Boyd, Milton J., DeMartini, John D. and Pic'l, Greg. 1981. Reconnaissance survey of Redwood National Park Area of Special Biological Significance. 127 pg.

NRBIB Abstract: Thirty-four miles of coastline are included within the Redwood National Park Area of Special Biological Significance (ASBS). This report discusses the plants and animals of the sand beaches and adjacent sandy bottoms of the southern part and the rocky intertidal/subtidal habitats more common in the north. The area is important partly because a number of species reach the limits of their range in this part of California, and also because near-shore turbidity results 'in the development of an unusual assemblage of plants and animals that is unique to this area of the California coast.' The 22 figures include indications of intertidal zonation at several areas, lithology of surface sediments, schematic drawings of the larger plants and animals, soil and land-use maps, and more. Fifteen tables provide data on salinity, precipitation, air and water temperatures, macroinvertebrate densities, common plant species, and others. Appendices: lists of animals (scientific names by phylum and class) of sand beaches and rocky intertidal areas in the ASBS; lists of marine intertidal algae, subtidal invertebrates, subtidal fishes, and subtidal flora.

A. AGENDA

Redwood National and State Parks
Marine Monitoring Scoping Session
January 27-28, 2004

Tuesday, January 27

8:30 am	Welcome—Bill Pierce, National Park Superintendent, Redwood National and State Parks Rick Sermon, State Park Superintendent, Redwood National and State Parks
8:40a	Introductions/announcements/moderator for presentations/ (Terry Hofstra)
9:00a	Overview of Klamath Network Inventory & Monitoring (I&M) marine ecosystem component (Dr. Penny Latham, Dr. Daniel Sarr) Goals of Scoping Session (Howard Sakai)
9:20a	RNSP's coastline: legislation/jurisdiction (H. Sakai), Aerial panorama (Greg Holm)
	Existing knowledge of marine ecosystem resources:
9:40a	Intertidal/subtidal zones Dr. Milton Boyd and Dr. John DeMartini
10:10a	Marine mammals/seabirds (Keith Bensen)
10:20a	BREAK
10:40a	Ocean processes (seasonal conditions, tides, currents, Klamath River plume) – (Dr. Greg Crawford)
10:55a	Geology: Descriptive overview - (Dr. Jeff Borgeld)
11:05a	Summary of CA Regional Water Quality Control Board 2003 report (Howard Sakai)
11:10a	Estuaries (Redwood Creek and Klamath River) (David Anderson)
	Overview of Current Marine Programs:
11:20a	On-going park programs (Greg Holm)
11:30a	Intertidal/subtidal I&M programs (Dr. Tim Mulligan/**Karah Cox** graduate student, Dr. Sean Craig/Cara McGary graduate student)
11:50a	Water quality research in Crescent City (Dr. Boyd/ **Karen Warburton** graduate student)
12:00 Noon	**LUNCH**
	Park Stressors (Potential stressors identified by park staff) to:
1:00p	1. Natural resources (Kristin Schmidt)
1:10p	2. Cultural resources (Karin Anderson)
1:20p	3. Other stressors? (All participants)
1:40p	Scoping Process: an overview (Gary Davis, facilitator)
2:00p	Workgroups (Determine WHAT stressors/indicators and WHY chosen) NOTE: Break-out groups will be determined by attendees.
3:00p	BREAK
3:15p	Continue in workgroups
4:25p	Tomorrow's agenda
4:30p	Adjourn

Wednesday, January 28

8:00a	Workgroups present summaries of stressors/indicators/rationale
8:30a	Workgroups (Begin work on the WHERE, WHEN, and HOW). Relate to goals (especially identifying levels of change needed, developing information necessary for writing project proposals or monitoring, Include data management in discussion?, etc.)
10:00a	BREAK
10:20a	Continue workgroup scoping
11:30a	Present workgroup summaries
12:00 Noon	LUNCH
1:00p	Present workgroup summaries
1:30p	Integrate workgroup comments into an overall conceptual model or ?
2:45p	Summarize findings of Scoping Session
3:30p	Closeout and Adjourn

B. RNSP WORKSHOP GOALS

1. **Determine conditions of current and future marine ecosystem integrity**
2. **Identify the stressors that cause abnormal conditions of marine ecosystem health**
3. **Identify indicators (vital signs) useful for providing early warnings of impending abnormal conditions of marine ecosystem health**
4. **Identify the level of change needed to detect abnormal conditions**
5. **Develop information necessary to write project statements for either inventories (for resources too poorly known to identify potential vital signs) or monitoring design studies for the vital signs identified during the workshop**

C. LIST OF PARTICIPANTS

Name	Affiliation
Dr. Sarah Allen	NPS, Senior Science Advisor, Point Reyes National Seashore
David Anderson	RNSP, Fish & Wildlife
Karin Anderson	RNSP, Cultural
Leonel Arguello	RNSP, Vegetation
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Bonnie Becker	NPS, Cabrillo National Monument
Keith Bensen	RNSP, Fish & Wildlife
David Best	RNSP, GIS
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Dr. Milton Boyd	Humboldt State University, Biology Dept.
Dr. Mark Colwell	Humboldt State University, Wildlife Dept.
Karah Cox	Humboldt State University, graduate student, Fisheries Dept.
Dr. Sean Craig	Humboldt State University, Biology Dept.
Dr. Greg Crawford	Humboldt State University, Oceanography Dept.
Dr. Gary Davis	NPS, Channel Islands National Park/Washington D.C.
Dr. John DeMartini	Humboldt State University, Biology Dept
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Corky Farley	RNSP, Ranger
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